NCEC-63C EPIC REPORT RESUME

EC C1C C61 1C-C6-66 24 (REV)

EXPERIMENTAL AVERSIVE STIMULATION OF VERBAL BEHAVIOR. (NO TITLE GIVEN.)

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BR-5-8C76
12-ALG-66
EDRS PRICE MF-$C.C9 HC-$2.32 58P.

*PSYCHOLOGICAL STUDIES, *VERBAL LEARNING, *RESEARCH METHODOLOGY, *CONDITIONED STIMULUS, TALLAHASSEE, FLORIDA

REPORTED HERE ARE RESULTS OF A STUDY INITIATED TO EXAMINE PRINCIPLES INVOLVED IN THE EXPERIMENTAL MODIFICATION OF VERBAL BEHAVIOR. SIXTEEN UNDERGRADUATE FEMALE VOLUNTEERS WERE REQUIRED TO PRODUCE A VERBAL RESPONSE UNDER MANIPULATED LIGHTING CONDITIONS. BASE LINE SCORES WERE OBTAINED FOR EACH SUBJECT UNDER DIMLIGHT CONDITIONS. PUSHBUTTON SCORES WERE OBTAINED TO MEASURE SUBJECT AWARENESS LEVELS RELATED TO NOXIOLS LIGHTING. CESSATION OF PREESTABLISHED LEVELS OF NOXIOUS LIGHT WAS THEN MADE DEPENDENT ON RESPONSE FREQUENCIES. INTENSITY AND INTERVALS OF NOXIOUS LIGHTING WERE VARIED AS REQUIRED FOR ACQUISITION, EXTINCTION, AND REACQUISITION OF CONDITIONING. RESULTS INDICATED THAT CONDITIONING WAS PREDICATED ON THE LEVEL OF SUBJECTS AWARENESS TO THE AVERSIVE STIMULUS. THE LEVEL OF AWARENESS WAS CONCLUDED TO BE SUBJECT SPECIFIC. METHODS USED HERE ARE HELD TO BE POTENTIALLY USEFUL FOR SCIENTIFIC EXAMINATION OF VERBAL CONDITIONING. IT IS CONCLUDED THAT TECHNIQUES WILL EVOLVE FROM THIS EXPERIMENT WHICH WILL ALLOW PRECISE AND SPECIFIC MANIPULATION OF VERBALIZATION IN THE CLASSROOM. (WN)

ED010054

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Final Report for Project 5-8076

Submitted to

Division of Elementary-Secondary Research
Department of Health, Education, and Welfare
U. S. Office of Education
Washington, D. C.

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August 12, 1966

Introduction

Operant techniques for the modification of human behavior have recently gained substantial respect as reflected by an ever-increasing literature. Sherman (1964) has reviewed instances where these techniques have been successfully applied to behavior disorders of wide and varied description. In a study by Zimmerman and Zimmerman (1962), this methodology was successful in eliminating unproductive behavior in a classroom setting.

Inasmuch as the educational process consists chiefly in the manipulation of behaviors which are primarily verbal in nature, it occurs that the operant conditioning of verbal contents provides not only a useful strategum for the analysis of this process, but also a technique which may be of value in the design of future educational endeavors. Unfortunately, basic research done in this area to date has generally not answered questions which must be answered prior to an attempt to apply these principles in any large scale educational program.

Reviews of the literature concerned with verbal conditioning (Krasner, 1956; Salzinger, 1959; Greenspoon, 1962) have highlighted several aspects of past investigations which emerge as methodological weaknesses.

Paramount among these deficits is the general failure of verbal conditioning studies to employ an experimental design in which subjects serve as their own controls. Several writers (Greenspoon, 1963; Salzinger, 1963) have commented on this failure, and have lamented the fact that intergroup comparisons of data have been the preponderant mode. The inferiority of the latter comparisons and the relative superiority of a functional design which relies primarily on intra-subject analysis has been aptly pointed out by Sidman (1962).

A second feature of verbal conditioning which has undoubtedly contributed greatly to disparity in findings both among experimenters and in replications by the same experimenter is the unreliability of reinforcing stimuli which have been employed. Discrepancies in findings of experiments which have used the same verbal reinforcing stimulus are particularly salient in the literature (Buss and Buss, 1958; Buss, Braden, and Orgel, 1956; Buchwald, 1959a, 1959b, 1960), and have also been in evidence in studies using non-verbal or mechanical reinforcing stimuli (Greenspoon, 1954; Taffel, 1955; Nuthman, 1957; McNair, 1957).

While typically great care has been taken to insure that verbal reinforcers are standard from subject to subject within an experiment, little care has been taken to stipulate the precise dimensions of the verbal stimulus such that it could be exactly duplicated by another experimenter. Even the precautions of defining the verbal reinforcer phonetically (Greenspoon, 1955) does not include differences in other dimensions such as intensity, pitch, and inflection which cannot be dismissed as unimportant without empirical sanction.

As compared to a verbal reinforcer, a non-verbal contingent stimulus can be stringently specified in terms of physical dimensions. Differences arising in findings both inter-experimenter and intra-experimenter can be then relegated to procedural or methodological dissimilarities or to the highly ideosyncratic reinforcement histories which subjects presumably bring with them to the experimental cubicle. While the latter condition has usually been assessed by statistical methods, recent writers persuade us (Skinner, 1953; Sidman, 1962) that inter-subject variability need not obscure functional relationships between pertinent variables provided the collection of proper individual baselines precedes the introduction of the independent variable.

Recently, some authors have attempted to relate the power of specific verbal contingent stimuli to increase the frequency of a given response class to post-experimental evaluations by the subject as to whether he "wanted" the reinforcement or not (Spielberger, Berger, and Howard, 1963; Spielberger and DeNike, 1963). The general desirability and feasibility of an independent estimation of the efficacy of a reinforcing stimulus has been suggested by Premack (1959, 1962) whose formulations do not rely on post-experimental verbal evaluations by the subject, but rather depend on stringently defined pre-experimental behavior measures. Similarly, Warren and Brown (1943) were able to relate conditionability of children in an operant situation to an independent behavioral measure which defined the desirability of the reinforcer. It occurs to the writer that this is one aspect of verbal conditioning studies which has been neglected quite conspicuously. An estimation of the power of a reinfrcing stimulus independent of the experimental contingency might well provide a partial explanation for inter-subject differences.

Only a few experimenters have attempted to modify human behavior by the operant application of aversive stimulation. Barrett (1962) found that in a male hospital patient, periods during which no tics were in evidence increased if these periods were followed by the cessation of noxious white noise. Similarly, Flanagan, Goldiamond and Azrin (1958) found that fluencies in stutterers increased if rewarded by cessation of a loud noise.

In a recent experiment Whaley and Dela Vergne, 1964 attempted to use aversive stimulation to modify verbal response classes in a paradigm which was constructed to get around many of the methodological weaknesses which have previously occurred in the verbal conditioning literature. Bright lights ranging in intensity from 180 to 1420 ft. candles were terminated for 5 seconds after the utterance of a member of the critical response class. A functional design was used throughout the experiment in which subjects served as their own controls. Several response classes were examined and the noxiousness of the various light intensities was determined prior to the experiment by a separate behavioral operation. Resultant findings indicated that aversive stimulation deployed in this manner increased the frequencies of the critical response classes. Further, this increase could be related to such variables as the absolute and psychophysical intensity of the light, the duration of the offset, and the response class on whose utterance the light offset was contingent.

While control of verbal content was demonstrated in the above study, several limitations of the reinforcement paradigm employed were dramatically pointed out. Since the procedure used was primarily escape training (Kimble, 1961, p. 69), it was impossible for the subjects to totally avoid noxious stimulation regardless of how often or how precisely temporally coordinated. The critical responses were emitted. Thus, responses which inadvertently coincided with the termination of a light-offset period were punished. Further, percentage of increase in the critical response was found to be negatively correlated with baseline frequency. These and other factors suggest that an escape paradigm presents serious limitations to the amount of stimulus control which can be gained over verbal responding. A more powerful paradigm is the avoidance schedule used by Sidman (1953) in which subjects may totally avoid noxious stimulation by the correct temporal utterance of the critical response. Requirements as to frequency and nature of the critical response can be totally programmed by the experimenter. Furthermore, avoidance responding has been shown to be more resistant to extinction and other forms of change which occur in the experimental situation.

The research reported here was aimed at examining the principles involved in the modification of human verbal content in an experimental situation designed to circumvent the methodological weaknesses which have made findings of the majority of previous studies uninterpretable and incapable of being worked into a body of working procedures which may ultimately be used for classroom and general group applications. Specifically, the following improvements were attempted: (a) A functional analysis utilizing extensive individual baselines over sessions was utilized. (b) A non-verbal reinforcing stimulus whose physical dimensions are strictly quantified throughout was used. (c) Prior to conditioning sessions an attempt was made to define the efficacy of the reinforcing stimulus by means of an independent operation. (d) A Sidman avoidance schedule was employed in this study.

Response Class

One of the most important considerations in verbal conditioning is the selection of a particular aspect of the subject's verbalization for modification. In application, verbal behavior which has been subjected to experimental manipulation in a free-operant situation has been of two general response types which have been designated "content" and "non-content." The former designation refers to those aspects of verbal behavior which are delineated in terms of some type of logical analysis of what the individual says. This structural analysis may be in terms of grammar such as plural nouns, first person pronouns, or may include all words or phrases which have similar meanings such as synonyms. The second general type of response class which has been used is the non-content class. In this instance physical aspects of verbal behavior are manipulated or operated on experimentally, such as duration of speech, intensity, or pitch.

In the present study a content measure of speech was selected for reinforcement and manipulation. The class which was selected was Human Responses. The definition of a Human Response which was employed in this study is identical to that first investigated by Matarazzo, Saslow and Pareis (1961). Any word which denoted a human being was considered a

member of this response class and was therefore reinforced during the experimental periods. Examples were men, doctor, nurse, children, brother, cousin, senator, soldier, etc. Words which referred to an organization such as club, army, legislature, etc., were not included in the response class and were therefore never reinforced.

Matarazzo et al. (1961) were successful in conditioning Human Responses in a situation where the subject uttered disjointed words as opposed to continuous speech. In a study which compared three types of content response classes, Whaley & Dela Vergne (1964) found Human Responses far superior to either plural nouns or first person pronouns. In this study continuous speech was investigated.

Method

Subjects

Sixteen undergraduate volunteers were chosen as subjects for this research project. Requirements were that the volunteers be female and be willing to devote 25 minutes daily to the experiment for an extended period of time, usually a full trimester. It was pointed out to prospective participants that once the experiment was begun, continued participation was required until completion. Subjects were paid adequately for their time and were made to feel that they were making a contribution to an important research project.

Age of the subjects ranged from 18 to 24, and, as a group, their academic interests and level of attainment varied greatly. Despite efforts to aprise the subjects of their obligations in the study, four subjects failed to complete the experiment for reasons of illness, termination of studies, or interference of other school activities.

As a group the subjects performed well, showed up for experimental sessions reliably, and gave evidence of considerable interest in the outcome of the research.

Apparatus

Physically, the experiment took place in two adjoining rooms 14 x 9 feet in dimension. A one-way mirror separated the two rooms. A plywood cubicle was constructed in one of the rooms which was 4 x 4 x 8 feet. A door provided access to the cubicle. Two plywood panels were arranged around the one-way mirror in a manner resembling a funnel. Light fixtures were mounted on these panels and these lights provided the aversive stimulation to the subject. A chair was placed in a stationary position facing the one-way mirror such that when seated the subject was approximately 34 inches away from the observation mirror. Nine light fixtures were arranged on 5 inch centers on each plywood panel. These two panels extended laterally from the observation window at 45 degree angles. The subject's chair was arranged such that he would receive maximum exposure from the array of lights. Light bulbs were screwed into the fixtures. Each panel had three rows of bulbs down and three rows across. Row one vertically was comprised of three 75 watt General Electric reflector flood

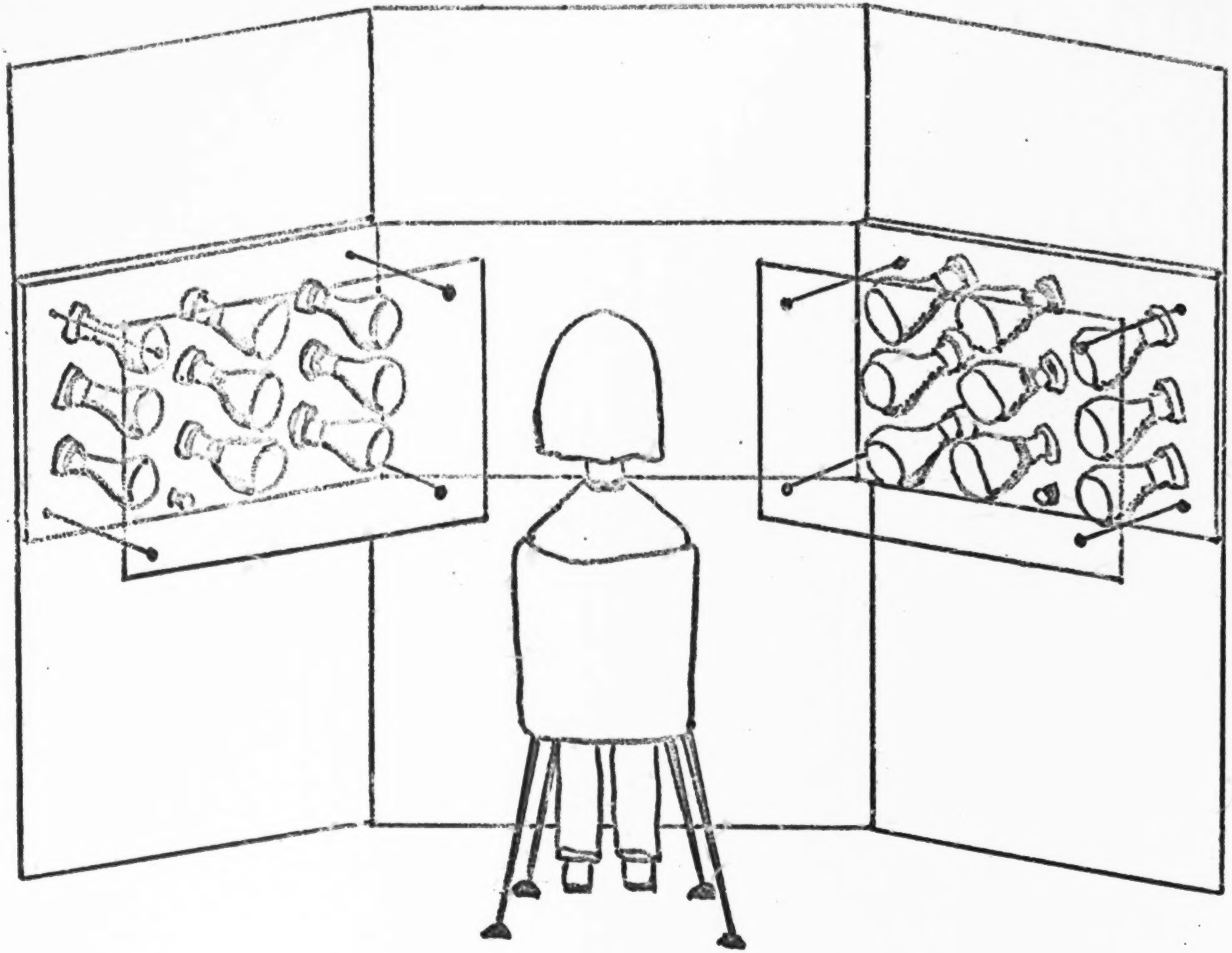
lamps, the middle row, three General Electric 375 Watt photo-flood lamps, and the third row, like the first, was comprised of 75 watt General Electric frosted flood lamps. The other panel was arranged in identical fashion. The lights impinged on the subject at a point an average of 24 inches from the source. A total of 3150 watts of power energized the array of lamps at maximum intensity. Vertical positioning of the lamps insured that the photic energy would strike the subject primarily in the region from the armpits to the top of the head. Figure 1 illustrates the positioning of the light panels, the arrangement of the individual lamps, and their geometrical relationship to the subject.

Insert Figure 1 about here

An electrical metronome was placed in the subject's cubicle and during operation acted as a pacer for the subject's verbal emissions. An intercom system linked the subject to the experimenter's room and in addition a microphone was affixed near the subject. This microphone lead to a tape recorder which recorded all the subject's verbalizations. A 17 x 20 x 1/4 inch clear plastic guard panel was placed between the subject and each of the light panels. This was installed to safeguard the subject's face and eyes in the unlikely event of the explosion of one of the light bulbs and to attenuate the heat from the bulbs. At the bottom of each panel a small light bulb acted to illuminate the cubicle area when the stimulus lights were not on. The cubicle was constructed to prevent the subject from turning away from the stimulus lights thus avoiding some of their noxious properties. The inside of the cubicle was painted white in order to enhance the illumination level during conditioning sessions. The room in which the cubicle was housed was air conditioned, and within the cubicle, fans were installed to dispell the heat generated by the lamps. An attempt was made to keep temperature constant during all sessions.

In the adjoining room the experimenter controlled the session and was able to observe the subject at all times. Two variable transformers allowed the experimenter to vary the illumination within the cubicle from the very low level provided by the house lights to a maximum of 1420 ft. lamberts. During operation illumination adjustments were made by increasing the voltage input to the light panels. Later, these voltage units were converted to ft. lamberts by measuring the photic output for each voltage level with an SEI photometer. Proximate to the experimenter was a relay rack containing the various components which controlled the temporal sequencing of the stimulus events. A bank of electronic counters recorded the subject's responses. A four pen event recorder recorded the frequency and temporal spacing of the subject's responses. A Webcor tape recorder recorded all verbalizations. A pushbutton allowed the experimenter to turn off the lights when an appropriate response was made. During light-on periods, a motor driven cam alternately opened and closed contacts leading to the light circuits such that lights flashed approximately three times per second. Previous studies had shown that flashing lights increased the psychophysical intensity of the lights. Table 1 presents measurements of light intensity for the various voltages used.

Fig. 1. Arrangement of light panels.



Insert Table 1 about here

Procedure

After subjects were accepted for use in the study, they were taken to the cubicle and seated. They were told that they should talk for 25 minutes about anything or topic they wished, but their speech should consist of sentences and that disjointed word sequences were not acceptable. The electric metronome was then turned on and the subject was told further that each word should match the beat of the metronome. The speed of the metronome was set for one beat per second and remained at that frequency throughout the experiment. At the onset some subjects had difficulty in adapting their speech pattern to the beat of the metronome, but after two or three sessions exhibited no further problems. When it was ascertained that the subject was able to adjust to this rather un-natural situation the procedure proper was begun. No subjects were dismissed for failure to comply with the metronome.

Baseline

The first sessions were devoted to the collection of data which would later serve as a reference point and thus give a basis for the estimation of the effectiveness of the independent variable. In single organism research designs, this procedure is called baseline collection. It consists in gathering data concerning the frequency of the response prior to the introduction of the independent variable. During this phase of the research subjects were placed in the cubicle and told to relax until they were signalled to start. After adjusting and setting recording equipment into action, the experimenter told the subject to begin by means of the intercommunication system and the subject began her verbalizations. During the baseline p riod, only the very dim house lights were energized. The frequency of Human Responses which the subject uttered were recorded on appropriate electronic counters. At the end of 25 minutes, the subject was instructed to stop and the quantities registered on the counters recorded in the data book.

Subjects differed in the number of sessions they continued on the baseline condition. Several factors entered into the decision of the termination of the baseline condition. Such factors as minimally acceptable variability across sessions, absence of apparent increasing or decreasing trends, and general impressions as to the subjects' adjustments to the experimental situation all contributed to the decision. The general scientific logic of such decisions in single organism research has been amply discussed by Sidman (1962).

Button-Pushing Sessions

After an adequate baseline had been collected, several sessions were devoted to a procedure designed to evaluate the aversiveness of the

Table 1

Level of Illumination Corresponding to Voltages Used in this Study

Voltage	Illumination in Ft. Candles
50	180.0
65	415.0
80	870.0
95	1217.0
110	1360.0
125	1380.0
140	1420.0

Note.--Light measurements were made with an SEI photometer at approximately 24 inches from light source.

various light intensities for each of the subjects. Subjects were seated in the experimental booth in the usual manner, but before they began their verbalization they were handed a push-button and given the following instructions.

> "During the next few sessions you will find that the lights go on from time to time. If they annoy you, you can turn them off for a short time by pushing this button. You may push the button as frequently as you wish without damaging it."

Subjects were then signalled to begin verbalizations. During the session the lights were varied through five different intensities ranging from 50 volts to 100 volts. The subject was exposed to each intensity for five minutes. Pushing the button turned off the lights for five seconds. Thus, for any intensity, 60 button pushes were required to keep the lights off for the full interval. The sequence in which the various intensities were presented to the subject varied from session to session. Intensities were presented in series of increasing intensity in one session and in the following session presented in a series of decreasing intensities. Number of button pushes were recorded for each intensity. Determinations were made for at least four ascending and four descending series for each subject. Some subjects reacted only slightly to the lights and it was necessary to proceed to higher intensity levels. For some subjects, determinations were made for four additional intensities ranging in ten volt steps from 100 to 140 volts.

There was wide individual variation in the button pushing behavior among subjects. Some subjects responded to all intensities of light and appeared to be quite uncomfortable during stimulation. Others showed little if any signs of physical discomfort from stimulation, regardless of intensity settings. This individual variation in reactivity to photic energy points out the necessity of pre-evaluation of reinforcing stimuli. (Warren & Brown, 1943).

Acquisition

This phase of the experiment was critical and is the first occasion in which the independent variable (cessation of intense illumination) was made contingent on the verbal response. The paradigm used during all acquisition sessions was one first introduced by Sidman (1953). Emission on the part of the organism of the correct response terminated the noxious stimulation and delayed its reoccurrence for a fixed period of time. In the Sidman schedule, programs of noxious stimulation (usually a timed shock) which occur at a fixed temporal interval are called shock-shock interval (S-S). If the organism, however, makes a correct response, shock is delayed for a longer interval, called the response-shock interval (R-S). This arrangement makes it advantageous to the organism to emit the correct response at intervals slightly shorter than the R-S interval. If the organism behaves in this manner, noxious stimulation is completely avoided.

The paradigm used in the present research differed from the typical Sidman design inasmuch as noxious stimulation (intense illumination) was consistently present until the subject emitted the correct verbal response. Utterance of a member of the Human Response class, was instrumental in turning off the lights for five seconds. Each response delayed the re-occurrence of the lights for five seconds. Thus, by uttering a member of the correct response class, at intervals slightly shorter than five seconds, the subject could completely avoid the lights. This general form of instrumental conditioning illustrates an example of negative reinforcement, in which cessation of noxious stimulation is contingent on a particular verbal response and results in an increase in the frequency of that response (Kimble, 1961, p. 59).

During acquisition sessions the pushbutton which had been previously used by the subject to avoid the lights was removed. Lights were turned on at the beginning of the session and remained on until the subject uttered a correct verbal response. At such time the experimenter energized the timer circuit which turned off the light for five seconds. Each correct response was instrumental in turning off the lights, or, if they were already off, delayed their onset for five full seconds.

The beginning intensity of the lights during the acquisition series was a function of the subject's previous behavior in the buttonpushing sessions. An intensity of light was chosen for each subject which she had previously reacted to by pushing the button on at least 20% of all opportunities. In this manner, it could be stated that a beginning level of illumination which was at least minimally noxious was introduced in inttial acquisition sessions.

Number of critical responses was recorded and plotted graphically for each session. Careful inspection for substantial increases in response frequency was made of these data. If after several sessions no increasing trend in response rate was discerned, intensity was increased. In some subjects, it was necessary to increase intensity several times before substantial conditioning was discernable. After an increase in response frequency was ascertained and was observed to remain for several sessions, an extinction phase was instrumented.

Extinction

Procedurally speaking, extinction demonstrates that changes observed in response frequency during acquisition can be attributed to the independent variable and are not due to spurious event or uncontrolled variables. Operationally, extinction consists in removal of the independent variable and should result in a decrease in response frequency (Sidman, 1962).

In the present study extinction consisted in turning off the stimulus lights throughout the experimental session. Since this operation precluded reinforcement of the correct response, it was expected that this would result in a reduction in the frequency of the response. The extinction procedure usually continued across several sessions until responding had stabilized at a level lower than that observed during acquisition.

Not all subjects underwent extinction procedure since they showed no increase over baseline responding during the acquisition procedure. In the case of two subjects, there was no time for extinction since the end of the school term precluded further experimentation.

Re-Acquisition

For some subjects time permitted the institution of a re-acquisition phase. This phase took place after increased responding observed in the initial acquisition condition had been obviated by the extinction procedure. Re-acquisition sessions in all cases employed a light intensity higher than that used in acquisition. The purpose of re-acquisition was to further demonstrate the effectiveness of the contingencies which constituted the independent variable, and to further demonstrate that rate or frequency of the conditioned verbal response was a function of the intensity of the illumination employed.

Results

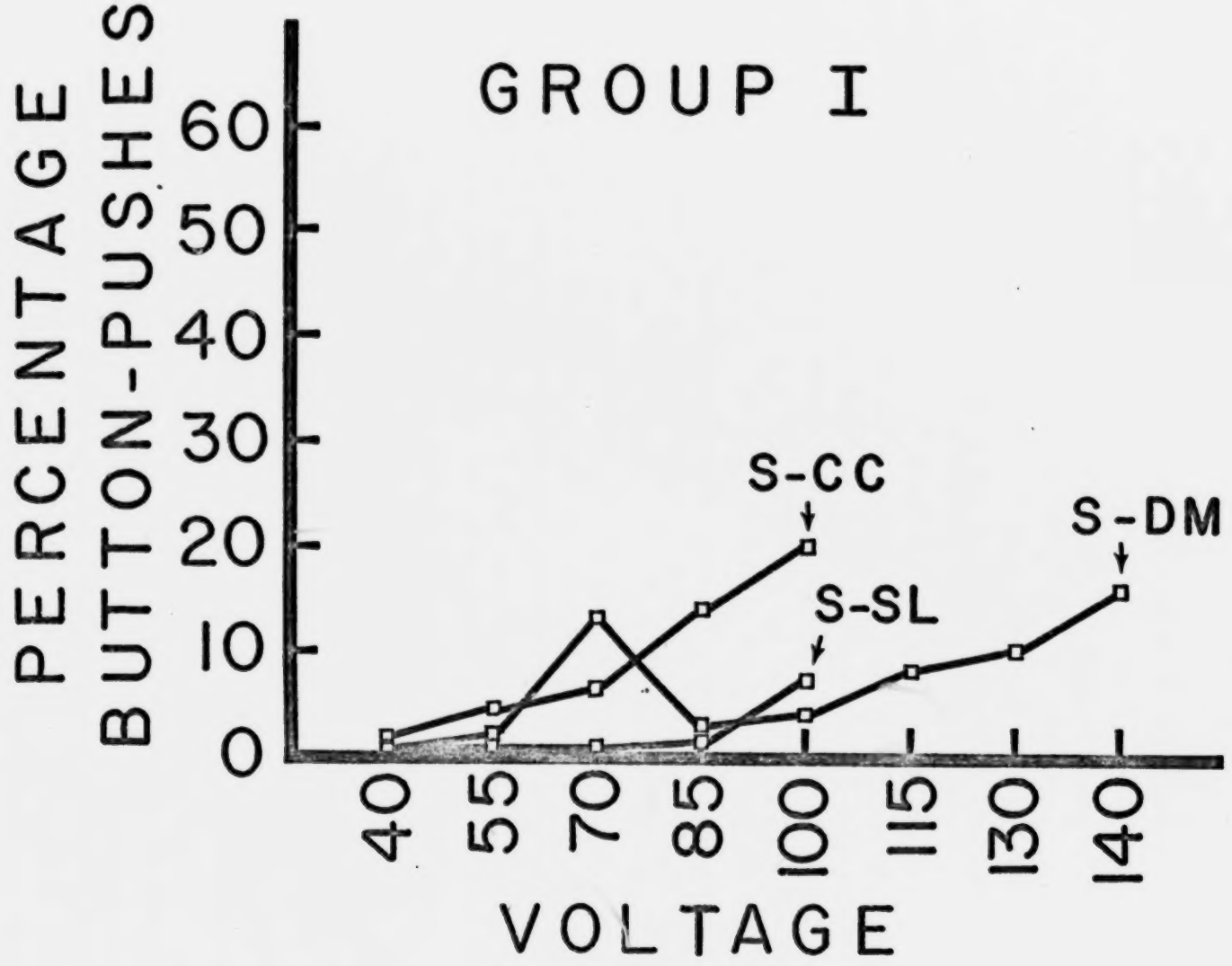
The button-pushing phase of this experiment was crucial since it allowed the experimenter to make an independent estimate of the aversiveness of the conditioning stimulus prior to its use in the acquisition procedure. Subjects were exposed to several different light intensities during button-pushing sessions and intensity remained constant for each five minute period. At the end of the five minute period the intensity was either increased or decreased in accordance with the particular series. Increasing and decreasing series were used on alternate sessions, and as such the procedure itself can be thought of as a modified version of the psychophysical method of limits. Data were recorded for each five minute period in terms of the frequency of button-pushes which the subject made for that particular intensity. Since each button-push turned off the lights for five seconds, the most optimum behavior on the part of the subject would be to emit a response (button-push) every five seconds. If this course was pursued, it can be seen that twelve responses were required for each minute, and sixty for each five minute intensity period.

Using the index of sixty button pushes for each five minute exposure, actual frequencies recorded during these sessions and for each intensity were expressed in terms of a percentage of this theoretical optimum. If a subject responded sixty times for a particular five minute exposure, the resulting quantity given him was 100%.

Figure 2 presents data expressed in the manner outlined above for subjects D.M., C.C., and S.L. Percentages were computed from frequencies observed in all button-pushing sessions for each intensity. It can be seen that none of the subjects whose data are presented here reached a percentage of performance higher than 30% regardless of intensity. This mode of performing will be referred to as Group I.

Insert Figure 2 about here

Fig. 2. Group I percentage data for button-pushing.


GROUP I
PERCENTAGE BUTTON-PUSHES
60
50
40
30
20
10
0
S-CC
S-DM
S-SL
40
55
70
85
100
115
130
140
VOLTAGE

Percentage button-pushing data for subjects J.L., S.H., L.D., D.F., J.D., and D.E. are depicted in Figure 3. It will be noted that all of these subjects reached a level above 30%, but below 60%. In further discussion, subjects who performed in this manner will be denoted Group II.

Insert Figure 3 about here

Three subjects, E.S., J.R., and S.D. comprise a third group (Group III), which is distinguished by a high degree of responding to the various stimulus intensities. All of these subjects achieved a level above 70%. This high frequency of response suggests that the lights were quite aversive to these subjects and should therefore provide adequate stimulation for conditioning to take place. The data for these subjects are presented in Figure 4.

Insert Figure 4 about here

Figure 5 illusfrates baseline and acquisition data for subject D.M. Baseline was collected for thirteen sessions. During this time the subject averaged approximately twelve Human Responses per session. With the exception of session nine when twenty-five responses were emitted, the frequency of responses per sessions ranged from five to fifteen thus indicating a stable rate of responding. On session fourteen cessation of illumination was made contingent on the uttering of a Human Response. Conditioning was begun with an intensity level of 80 volts. On session 26 intensity was increased to 95 volts, on session 28 to 125 volts, and finally on session 32 a maximum intensity of 140 volts was employed. It can be seen from Figure 5 that introduction of the independent variable, namely, making cessation of the illumination contingent on the verbalization of the correct response, did not increase response rate as might be predicted. Furthermore, there is indication that response rate was actually reduced by introduction of the contingency. The results of acquisition of subject D.M. can be summarized by stating that response rate was reduced and in general responding became stabilized as a result of the contingency.

Insert Figure 5 about here

Figure 6 presents baseline and acquisition data for subject C.C.

Insert Figure 6 about here

Fig. 3. Group II percentage data for button-pushing.

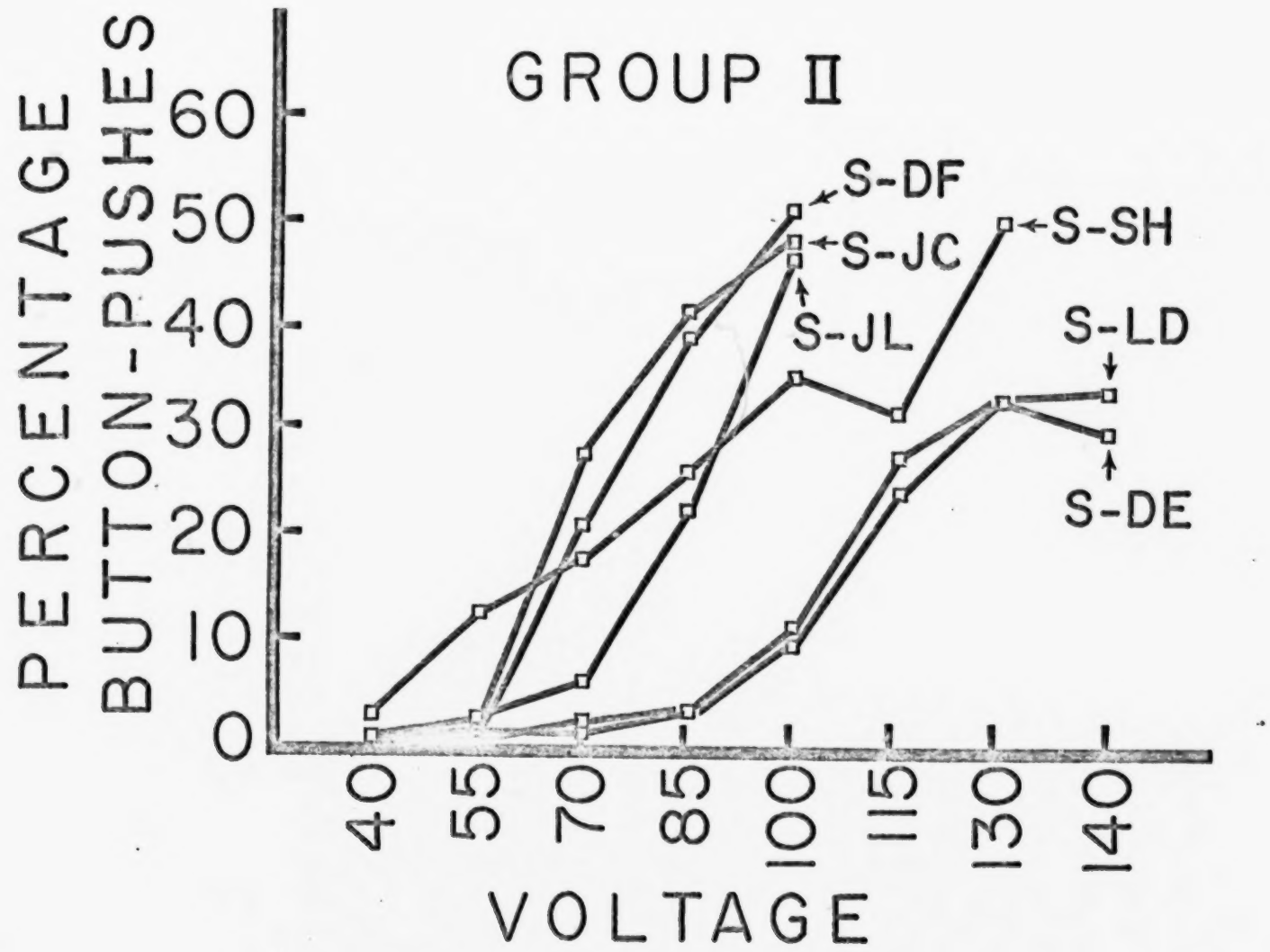

GROUP II
S-DF
S-JC
S-JL
S-SH
S-LD
S-DE
PERCENTAGE BUTTON-PUSHES
0
10
20
30
40
50
60
40
55
70
85
100
115
130
140
VOLTAGE

Fig. 4. Group III percentage data for button-pushing.

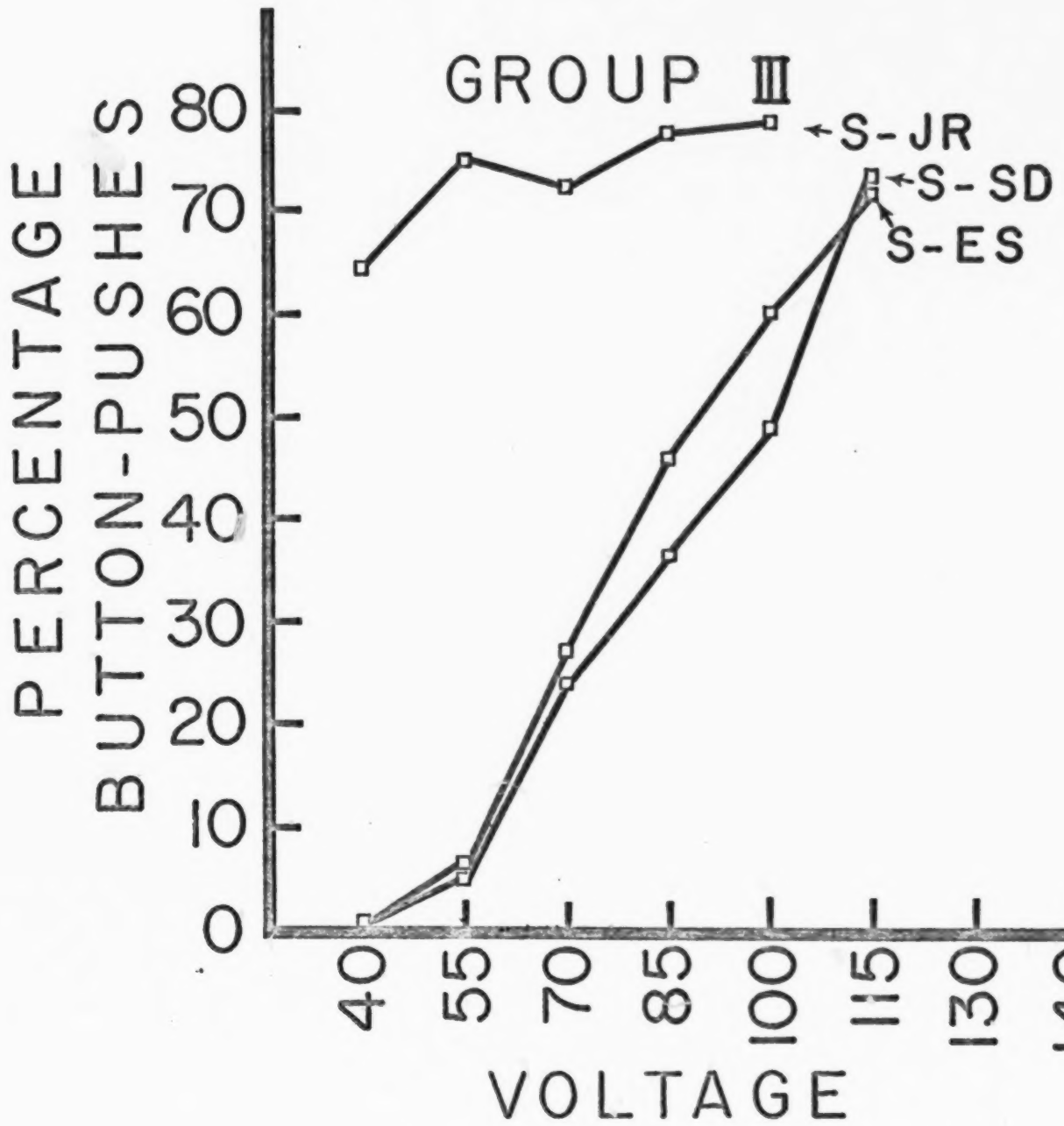

GROUP III
S-JR
S-SD
S-ES
PERCENTAGE BUTTON-PUSHES
0
10
20
30
40
50
60
70
80
40
55
70
85
100
115
130
140
VOLTAGE

Fig. 5. Baseline and acquisition data for D.M.

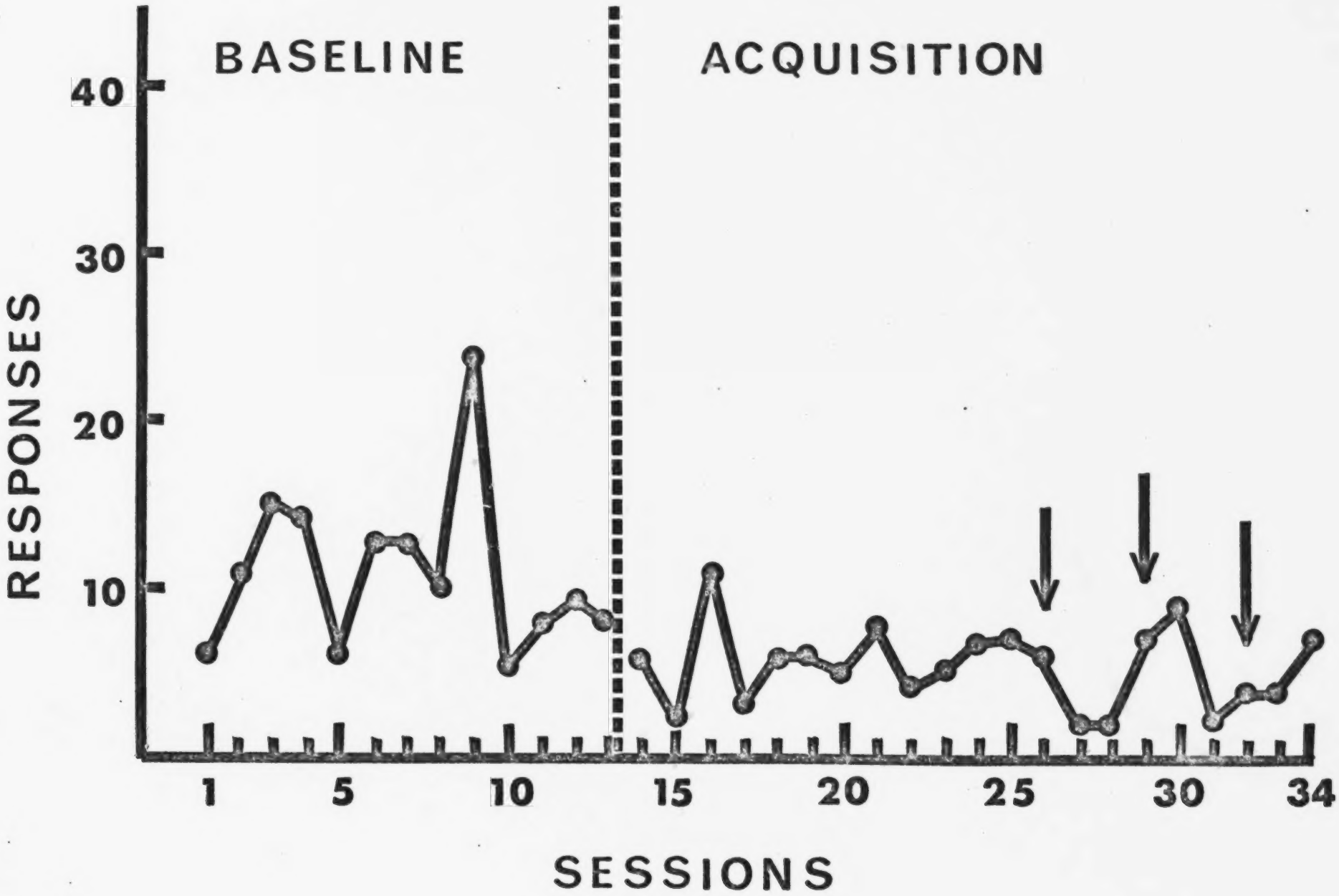
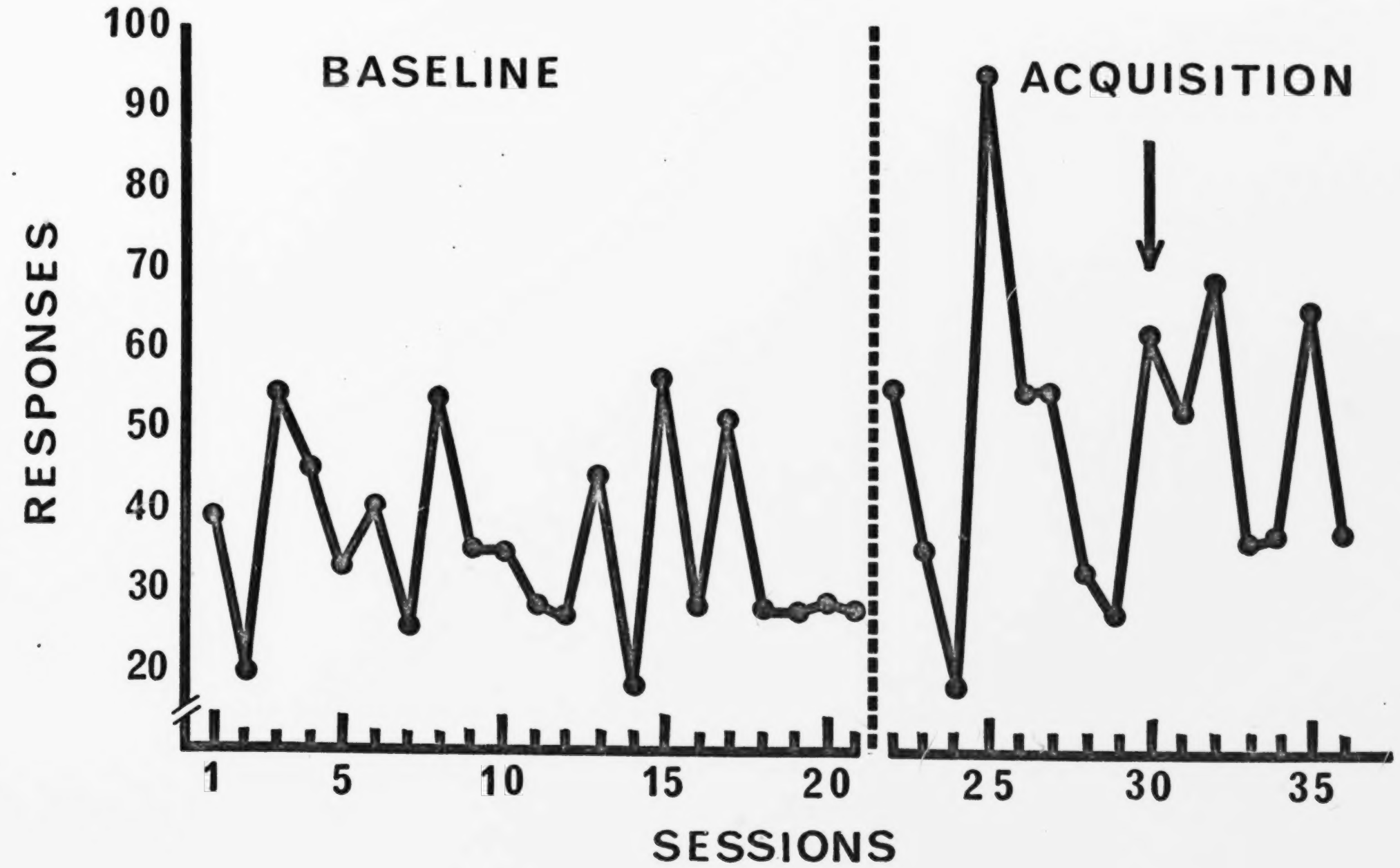

SUBJECT D. M.
BASELINE
ACQUISITION
RESPONSES
40
30
20
10
1
5
10
15
20
25
30
34
SESSIONS

Fig. 6. Baseline and acquisition data for C.C.


SUBJECT C.C.
BASELINE
ACQUISITION
RESPONSES
100
90
80
70
60
50
40
30
20
1
5
10
15
20
25
30
35
SESSIONS

Baseline data were collected for 21 sessions during which an approximate average of 38 Human Responses were made per session. Response rate ranged from 17 to 56 responses over the baseline sessions. On the last four sessions there was an indication of stability at about 26 responses. On the 22nd. session the contingency was introduced and utterance on the part of the subject of a Human Response was instrumental in eliminating the stimulus illumination for a period of five seconds. Initially intensity was adjusted to the 100 volt level. On session 30 intensity was increased to 130 volts. The results of the introduction of the independent variable are equivocal. While there is suggestion of conditioning (session 25), these effects are ephemeral and do not hold up over subsequent sessions. In addition, the introduction of a higher intensity of illumination on session 30 did not increase rate appreciably. The occurrence of a reliable degree of conditioning with subject C.C. is highly questionable, although it must be stated that a trend toward increased responding was discernable.

Subject S.L. (Figure 7) emitted quite variable baseline behavior in which the range of responses was from 60 to 16 responses. The average across the 19 baseline sessions was approximately 28 responses. On the 20th session the stimulus lights were introduced at an intensity setting of 100 volts. There were no immediate effects, but on the 23rd session responding dropped appreciably and remained low for the next two sessions. On the 26th session intensity was increased to 125 volts. It can be seen that introduction of the contingency in the acquisition phase tended to suppress responding below baseline, and is thus contrary to the expected increase in response rate. This effect which will be noted in several other subjects is of theoretical importance and will be dealt with in some detail in the discussion section.

Insert Figure 7 about here

Figure 8 presents the baseline and acquisition data for subject J.L.

Insert Figure 8 about here

Baseline performance for subject J.L. begins at a reasonable 25 responses but quickly drops to an extremely low level and finally on session 10 only one Human Response was emitted. In subsequent baseline sessions responding increased and reached a peak on session 19. The acquisition phase began on session 21 when the contingency was introduced. Light intensity was set at 100 volts. On session 31 intensity was increased to 115 volts, on session 32 to 130 volts, and on session 39 maximal intensity of 140 volts was employed. Examination of subject J.L.'s data shows no systematic or discernable effect on the contingency on her behavior, regardless of intensity.

Fig. 7. Baseline and acquisition data for S.L.

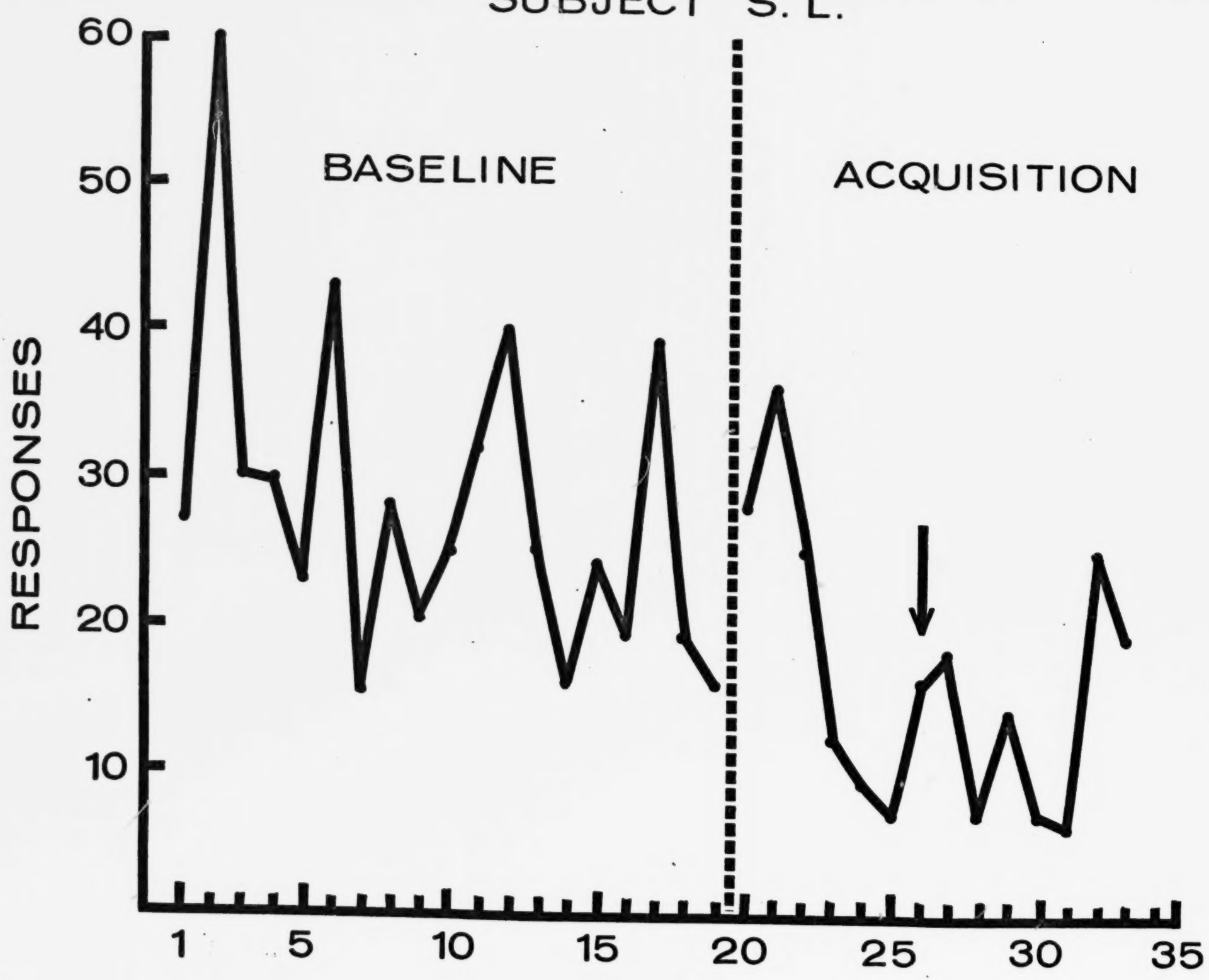
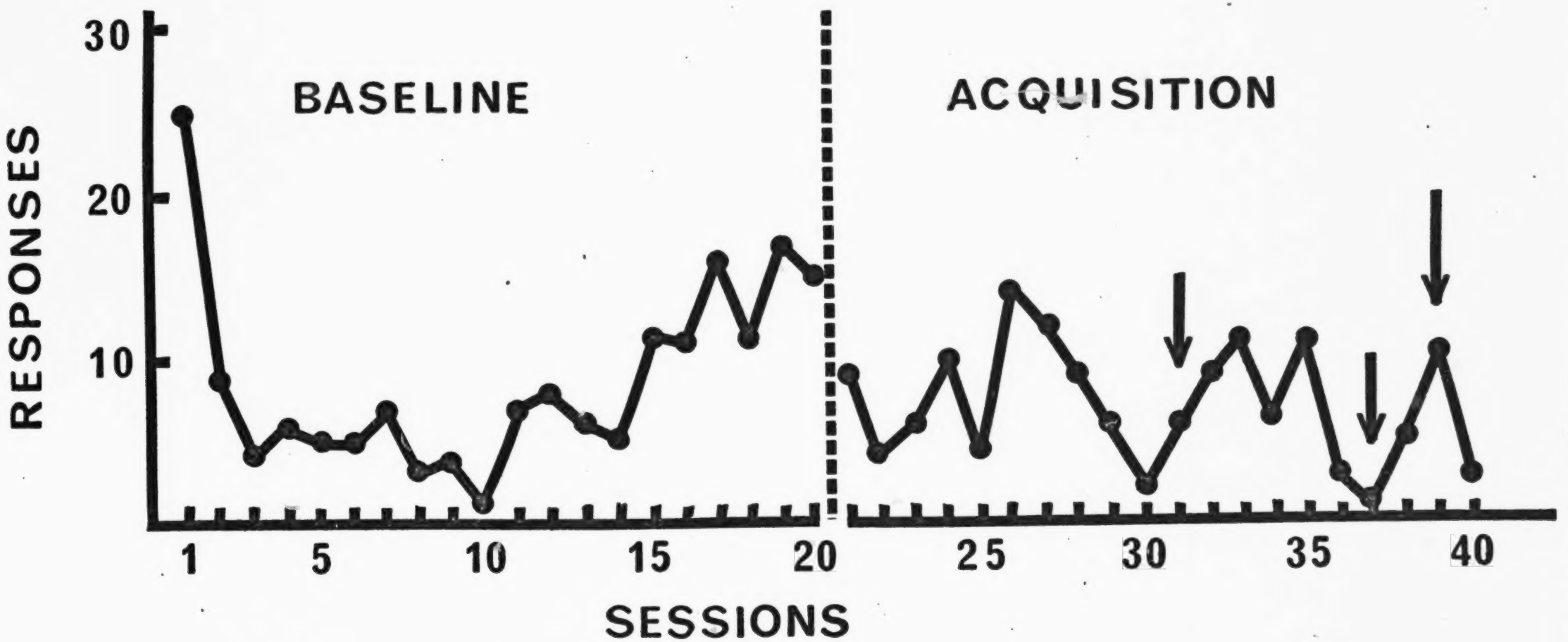

SUBJECT S. L.
BASELINE
ACQUISITION
RESPONSES
60
50
40
30
20
10
1
5
10
15
20
25
30
35
SESSIONS

Fig. 8. Baseline and acquisition data for J.L.


SUBJECT J. L.
30
20
10
RESPONSES
BASELINE
ACQUISITION
1
5
10
15
20
25
30
35
40
SESSIONS

Subject S.H. responded in a variable manner during the baseline period. The range of responses was from 13 to 46 with an approximate average of thirty (Figure 9). On the 23rd session the contingency was introduced. Responding remained below the baseline average for several days and then on day thirty reached a high of fifty responses. This increase did not remain and responding soon dropped below the baseline average. On session 43 the light intensity was increased from 100 units to 130 units. Over the next few sessions there were no substantial increases in responding. Responding by subject S.H. can be described as indicating no substantial effects of the introduction of the independent variable. However, there was an indication of an increase in responding which was followed immediately by a drop in responding well below the baseline average. This phenomenon, which is difficult to explain in terms of the experimental design has been observed in other subjects and will be discussed later.

Insert Figure 9 about here

Figure 10 presents data for subject L.D.

Insert Figure 10 about here

During the sixteen sessions of baseline subject L.D. responded with minimal variability and had an approximate average of 19 responses per session. On the 17th session the contingency was introduced and intensity was set at 100 volts. While an immediate response on the part of the subject was to increase response frequency, this trend was ephemeral and rate stabilized at about baseline magnitude. On session 42 intensity was increased to 130 volts without any dramatic effects. On session 48 intensity was increased to the maximum of 140 volts. Throughout the next seven sessions responding increased until a maximum of 120 responses was attained. This significant increase can be attributed to the effect of the introduction of the contingency, and as such demonstrates verbal conditioning of the critical response class. Unfortunately, the subject was not available for further experimentation since by the end of 56 sessions the trimester was terminated and the subject's obligation completed. For this reason extinction and re-acquisition procedures were not possible.

Subject D.F. exhibited a low stable baseline which did not warrant extension past ten days (Figure 11). On the eleventh day the contingency was introduced at an intensity setting of 100 volts. On session 15 a gradual increase in responding was discerned and on sessions 15 through 17 responding increased to a maximum of 340 responses; a rate larger than baseline by several factors. On session 22 an extinction procedure was begun in which all stimulus lights were turned off and the response was no longer instrumental in turning off the lights. On the first extinction session responding dropped to less than half of the previous sessions rate. In the following three sessions responding had returned to a level comparable with baseline.

Fig. 9. Baseline and acquisition data for S.H.

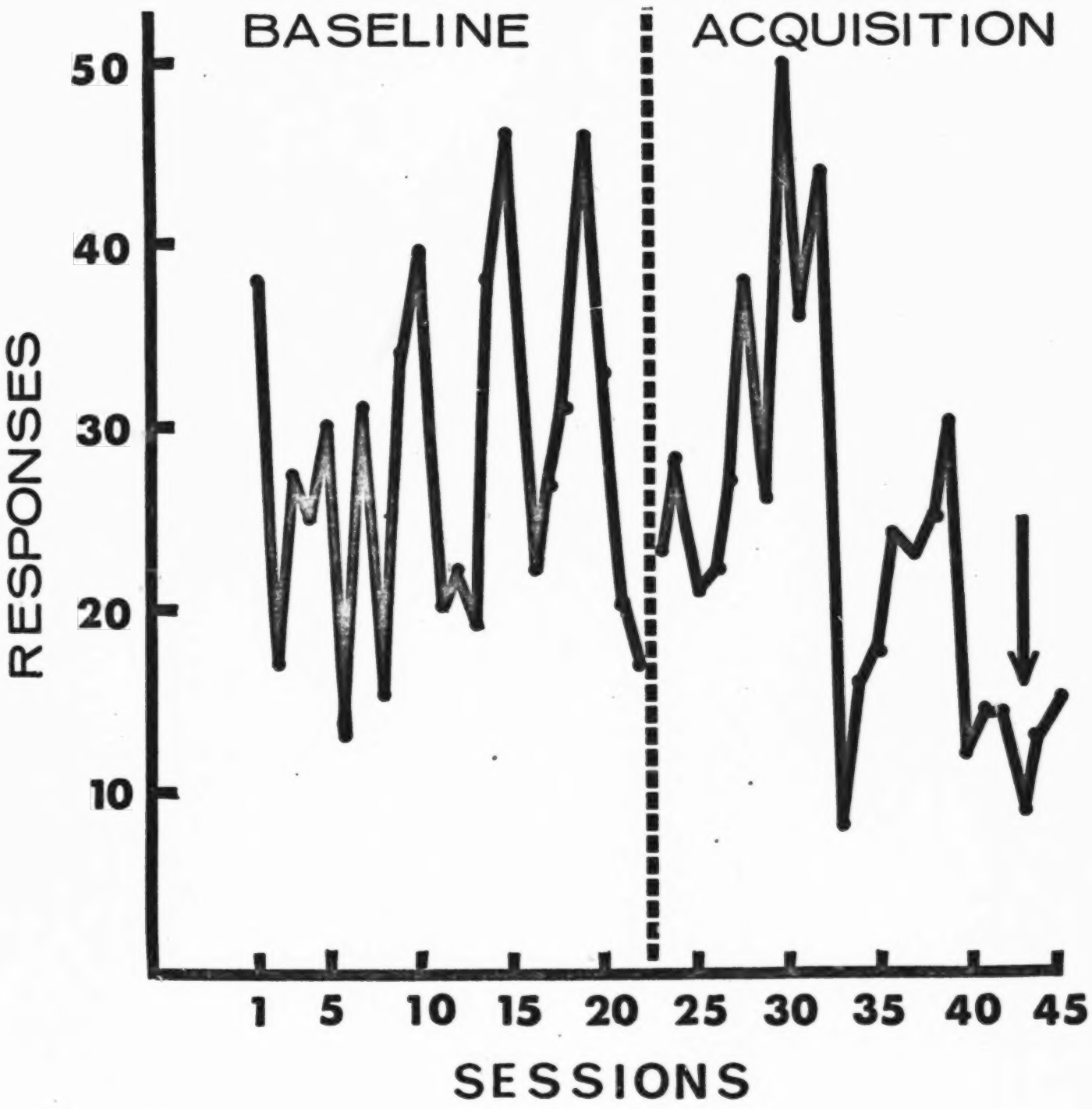
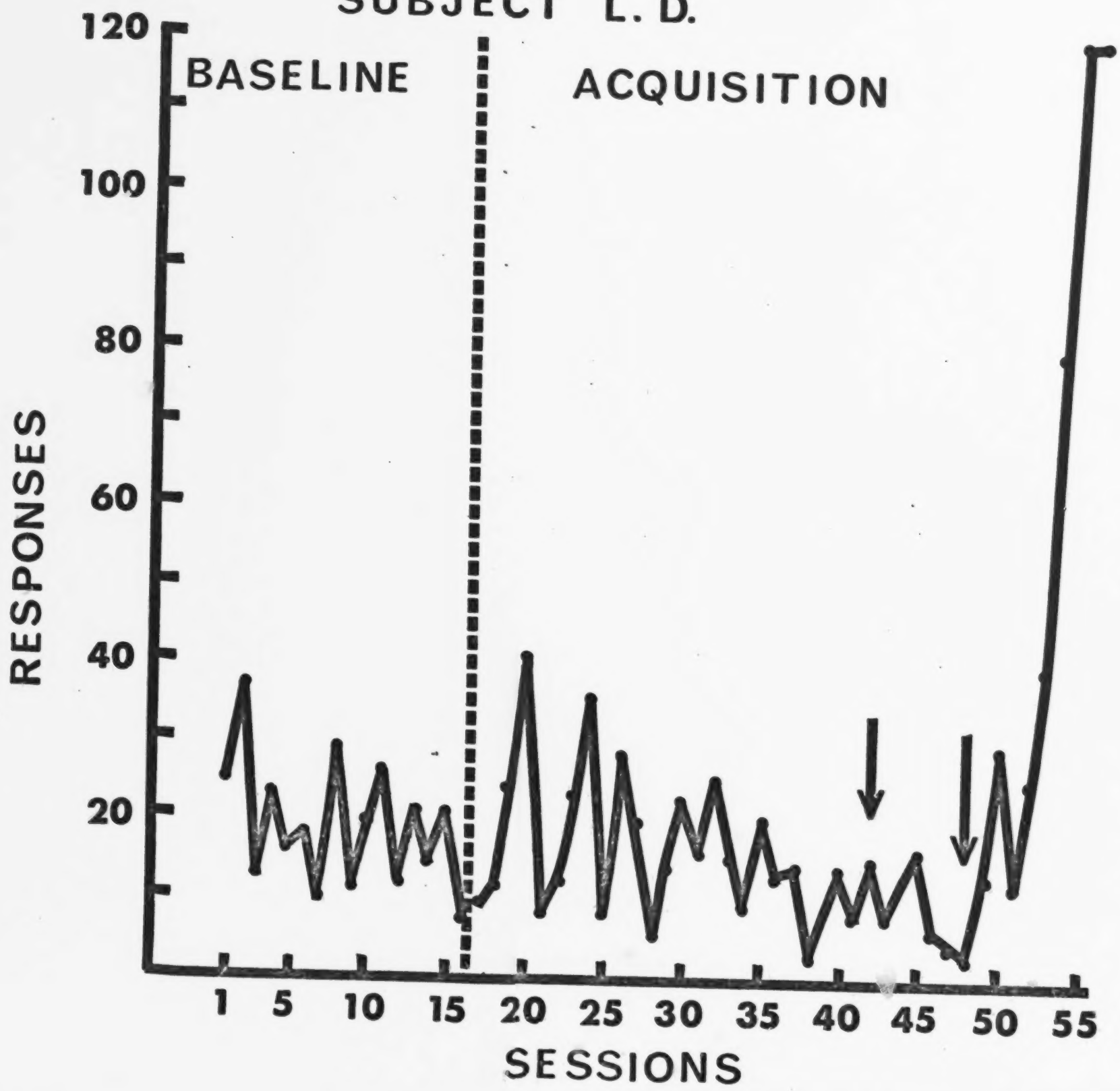

SUBJECT S.H.
BASELINE
ACQUISITION
RESPONSES
50
40
30
20
10
1
5
10
15
20
25
30
35
40
45
SESSIONS

Fig. 10. Baseline and acquisition data for L.D.


SUBJECT L. D.
BASELINE
ACQUISITION
RESPONSES
120
100
80
60
40
20
1
5
10
15
20
25
30
35
40
45
50
55
SESSIONS

Insert Figure 11 about here

After 14 sessions of extremely stable baseline behavior, subject J.C. (Figure 12) was introduced to the contingency on session 15. There was no resultant change in response rate and intensity was increased from the original level of 95 volts to 120 volts on session 23 to 130 volts on session 25, and finally to 140 volts on session 27. There was an immediate increase in response rateafter the last increase to a magnitude of 212 responses. On session 30 a maximum response rate of 330 responses was obtained. On the following session an extinction procedure was introduced and response rate dropped to 32 responses and then to a level below the baseline average. Experimentation was terminated with this subject at the end of the 34th session.

Insert Figure 12 about here

Figure 13 presents the baseline and acquisition data for subject D.E.

Insert Figure 13 about here

After 19 sessions of baseline responding, the contingency was introduced on session 20. The initial intensity employed was 100 volts. There was no apparent effect of the introduction of the independent variable during the following 18 sessions. On session 40 the intensity was increased to 130 volts and a concomitant dramatic increase in response rate was discernable. On the final acquisition session response rate had reached approximately 100, roughly a 900% increase over baseline responding. Time did not permit extinction or re-acquisition procedures to be enacted.

After 17 days of generally decreasing response frequencies, subject E.S. (Figure 14) was introduced to the contingency on session 18. Ten sessions of stable but fairly low responding followed until on session 31 a generally increasing trend began. On session 45 the light intensity was increased from the initial level of 95 volts to 120 volts. Response rate increased immediately to a maximum of over 120 responses and thereafter decreased to a stable level of approximately 65. On session 55 an extinction procedure was instituted which resulted in decreased responding which reached a level approximating baseline on session 57.

Fig. 11. Baseline, acquisition and extinction data for D.F.

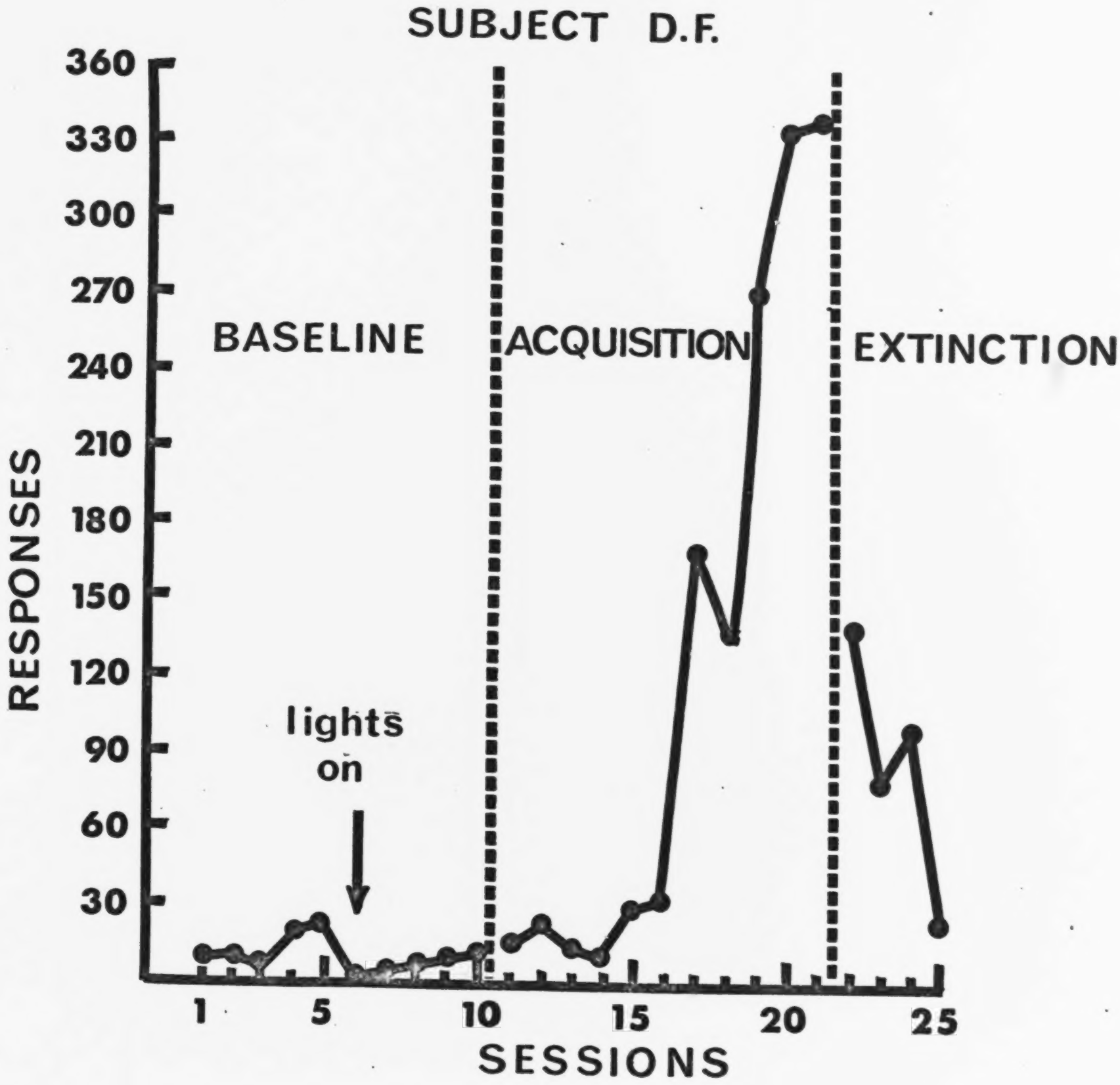

SUBJECT D.F.
360
330
300
270
240
210
180
150
120
90
60
30
RESPONSES
BASELINE
ACQUISITION
EXTINCTION
lights
on
1
5
10
15
20
25
SESSIONS

Fig. 12. Baseline, acquisition and extinction data for J.C.

SUBJECT J. C.

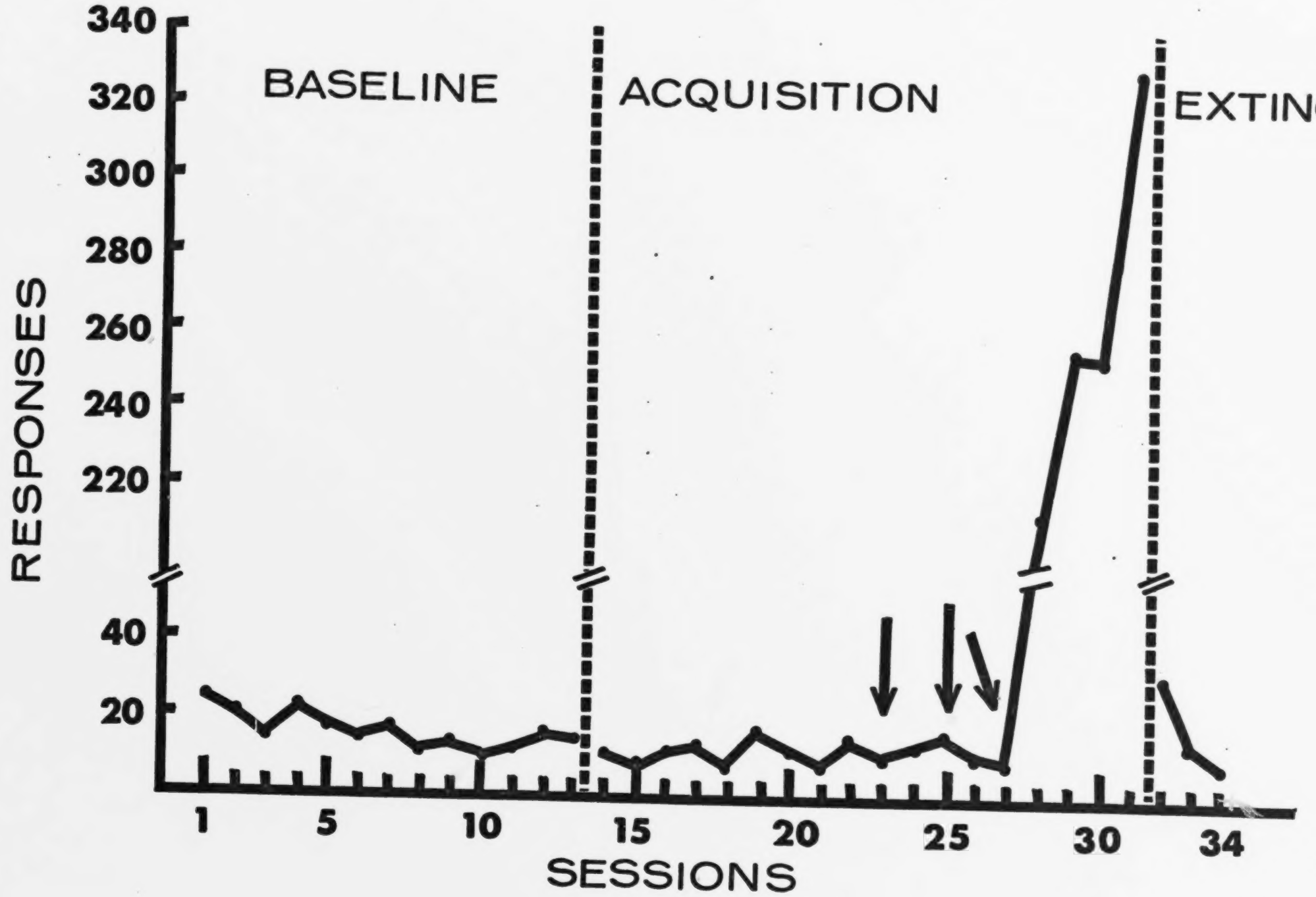
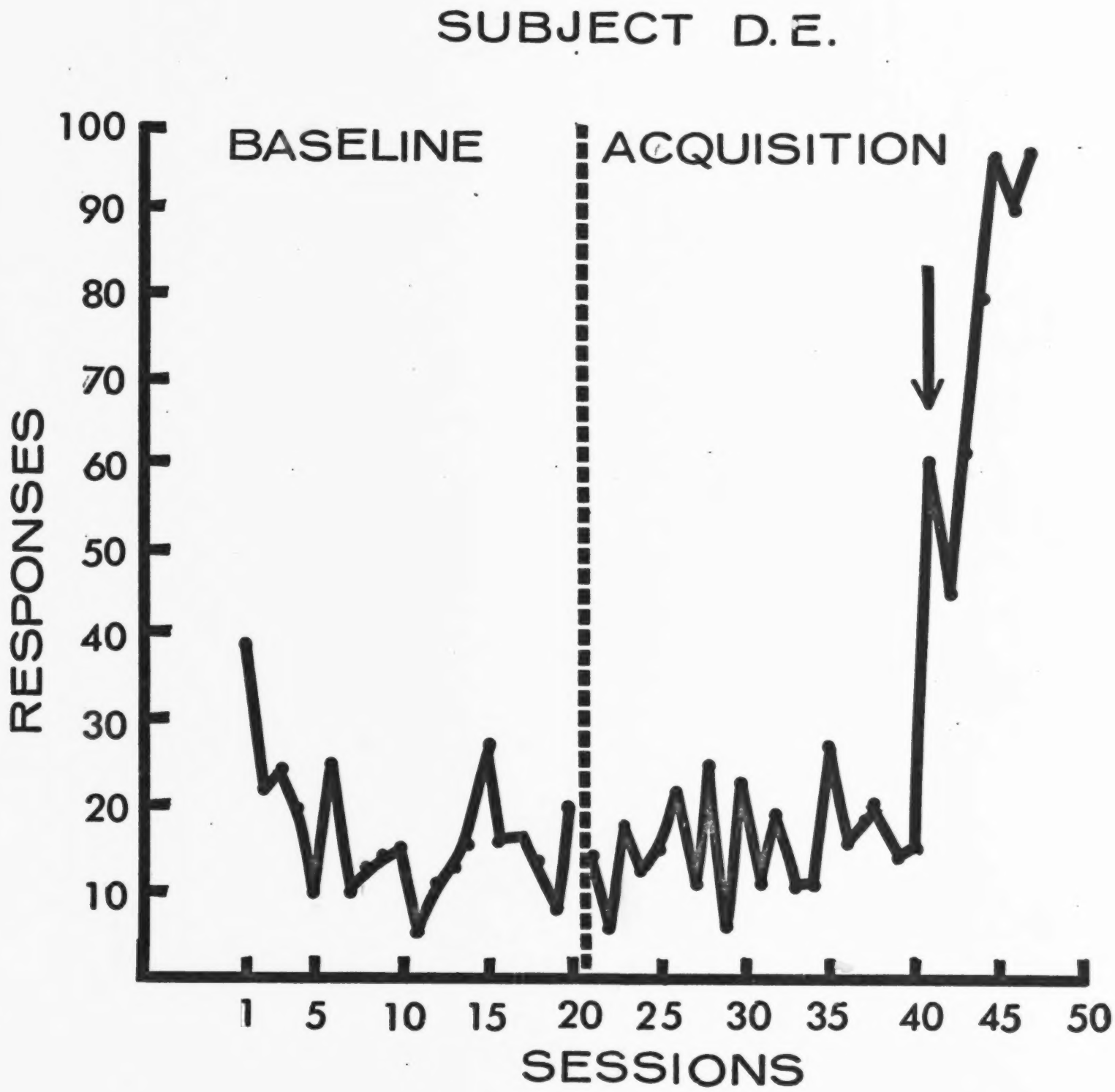

340
320
300
280
260
240
220
40
20
RESPONSES
BASELINE
ACQUISITION
EXTINCTION
1
5
10
15
20
25
30
34
SESSIONS

Fig. 13. Baseline and acquisition data for D.E.


SUBJECT D. E.
BASELINE
ACQUISITION
RESPONSES
100
90
80
70
60
50
40
30
20
10
1
5
10
15
20
25
30
35
40
45
50
SESSIONS

Insert Figure 14 about here

Subject J.R. (Figure 15) was subjected to all conditions of experimentation which included baseline, acquisition, extinction, re-acquisition, and a second extinction phase. After 10 sessions of stable responding in which the response average was approximately 17 responses per session, the contingency was introduced at an intensity level of 100 volts. On the second acquisition session responding increased dramatically to approximately 120 responses. In the next few sessions responding decreased from this maximum, but remained at a level above baseline responding. On session 16 an extinction procedure was instituted and response rate immediately dropped to a level comparable with the baseline response level. On session 21 a re-acquisition stage was instituted and responding raised immediately to that observed during the first acquisition period. On session 23 a final extinction phase was instrumented and responding returned to the baseline level. The behavior demonstrated by this subject exhibited the control on verbal responding which the independent variable had, and alternate acquisition and extinction procedures demonstrated this control beyond any reasonable doubt.

Insert Figure 15 about here

The final subject whose data are to be presented here is subject S.D. During 19 baseline sessions this subject performed with a response rate which was in general quite variable and which averaged approximately 37 responses. On session 20 the contingency was introduced and no discernable change in responding occurred through session 45. On session 46 the initial light intensity level was increased from the initial value of 100 volts to 115 volts. An immediate increase in responding was observed and on session 50 subject S.D. emitted more than 100 Human Responses. On session 51 an extinction procedure was instrumented. Responding decreased over the next few sessions in a decremental fashion. By session 54 response rate had returned to a magnitude comparable to that observed during the baseline period.

Insert Figure 16 about here

Discussion

Of the twelve subjects for whom data have been presented, it can be said that seven exhibited verbal conditioning in which cessation of

Fig. 14. Baseline, acquisition and extinction data for E.S.

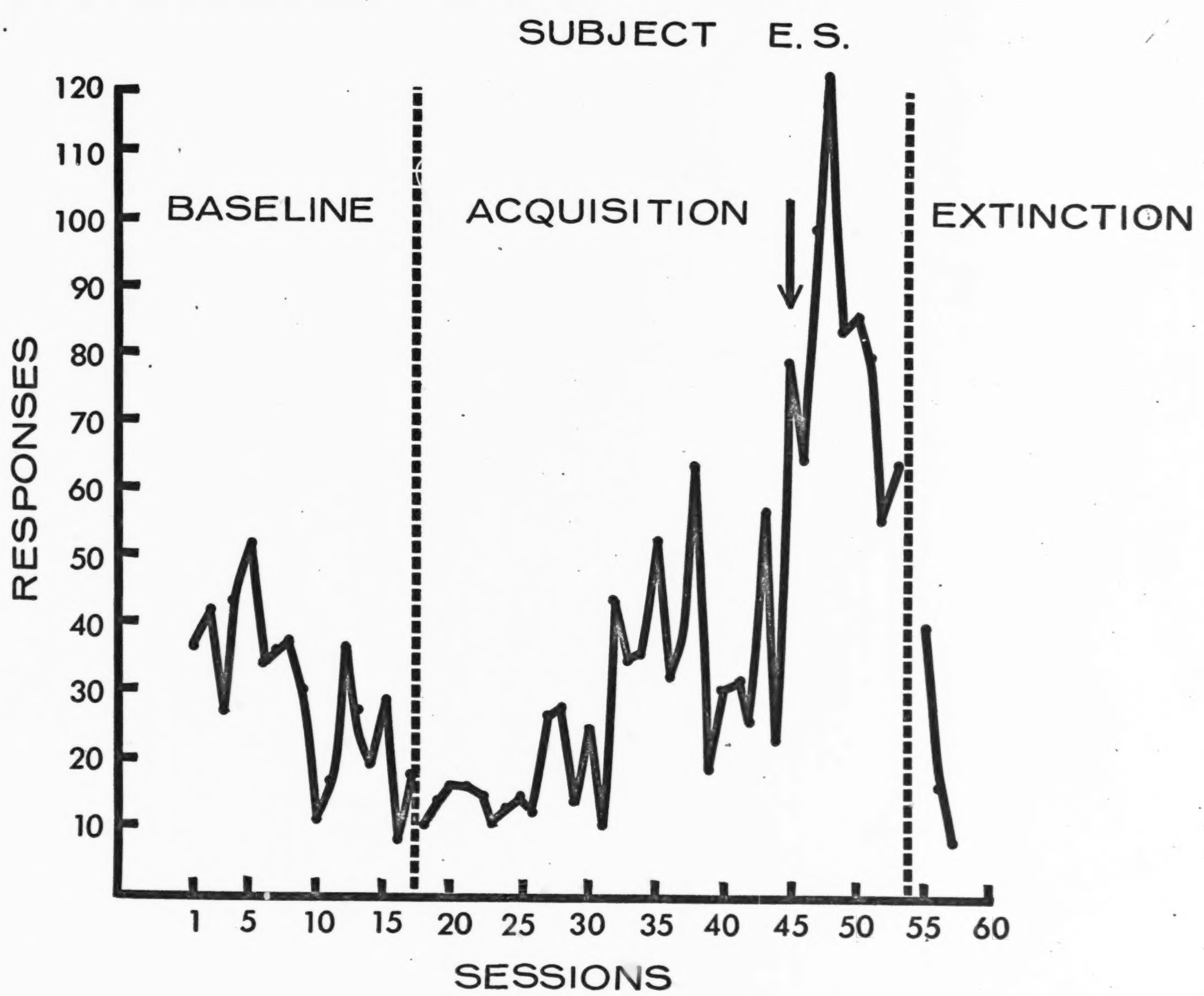

SUBJECT E.S.
BASELINE
ACQUISITION
EXTINCTION
RESPONSES
120
110
100
90
80
70
60
50
40
30
20
10
1
5
10
15
20
25
30
35
40
45
50
55
60
SESSIONS

Fig. 15. Baseline, acquisition, extinction, re-acquisition and extinction data for J.R.

SUBJECT J. R.

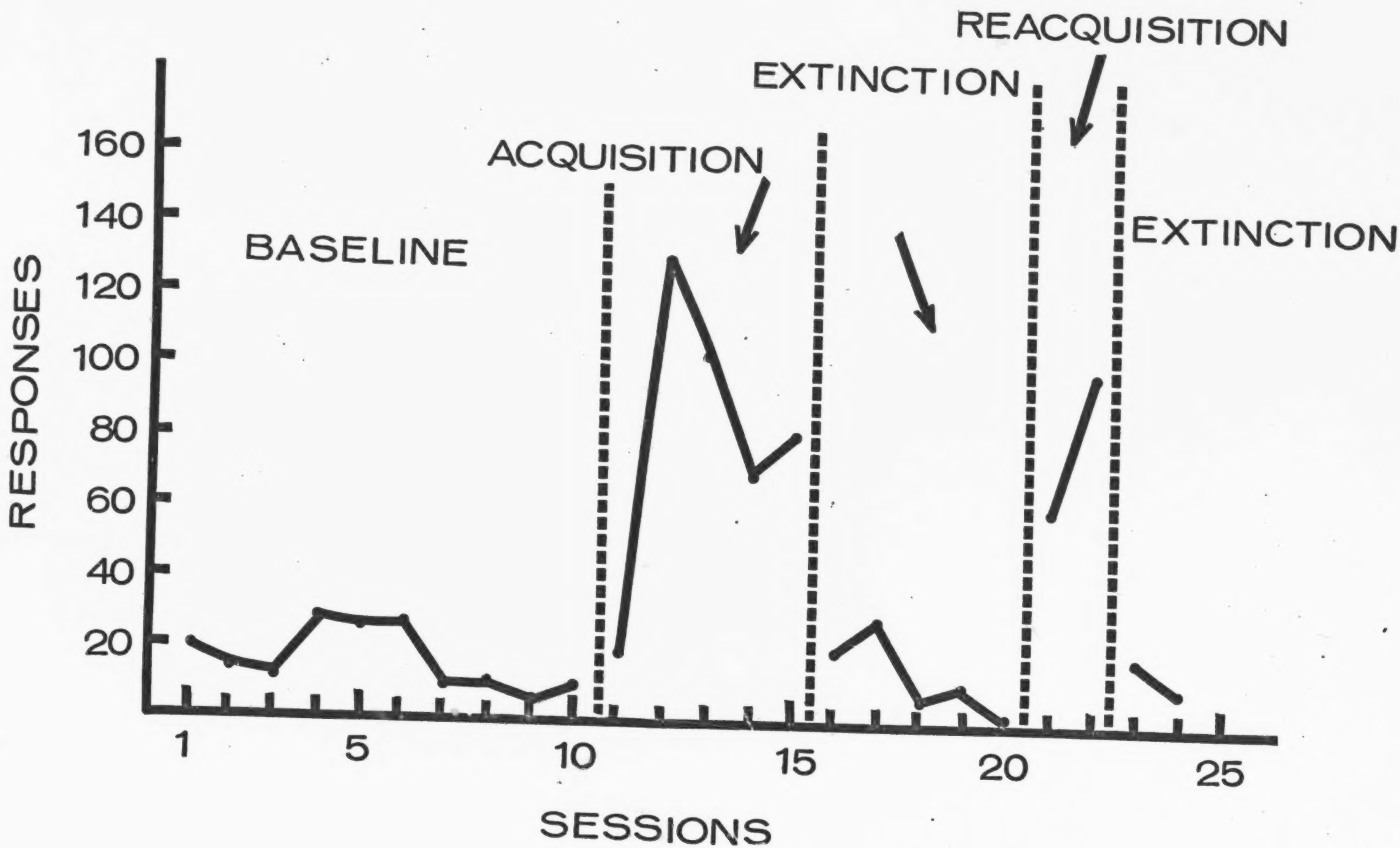
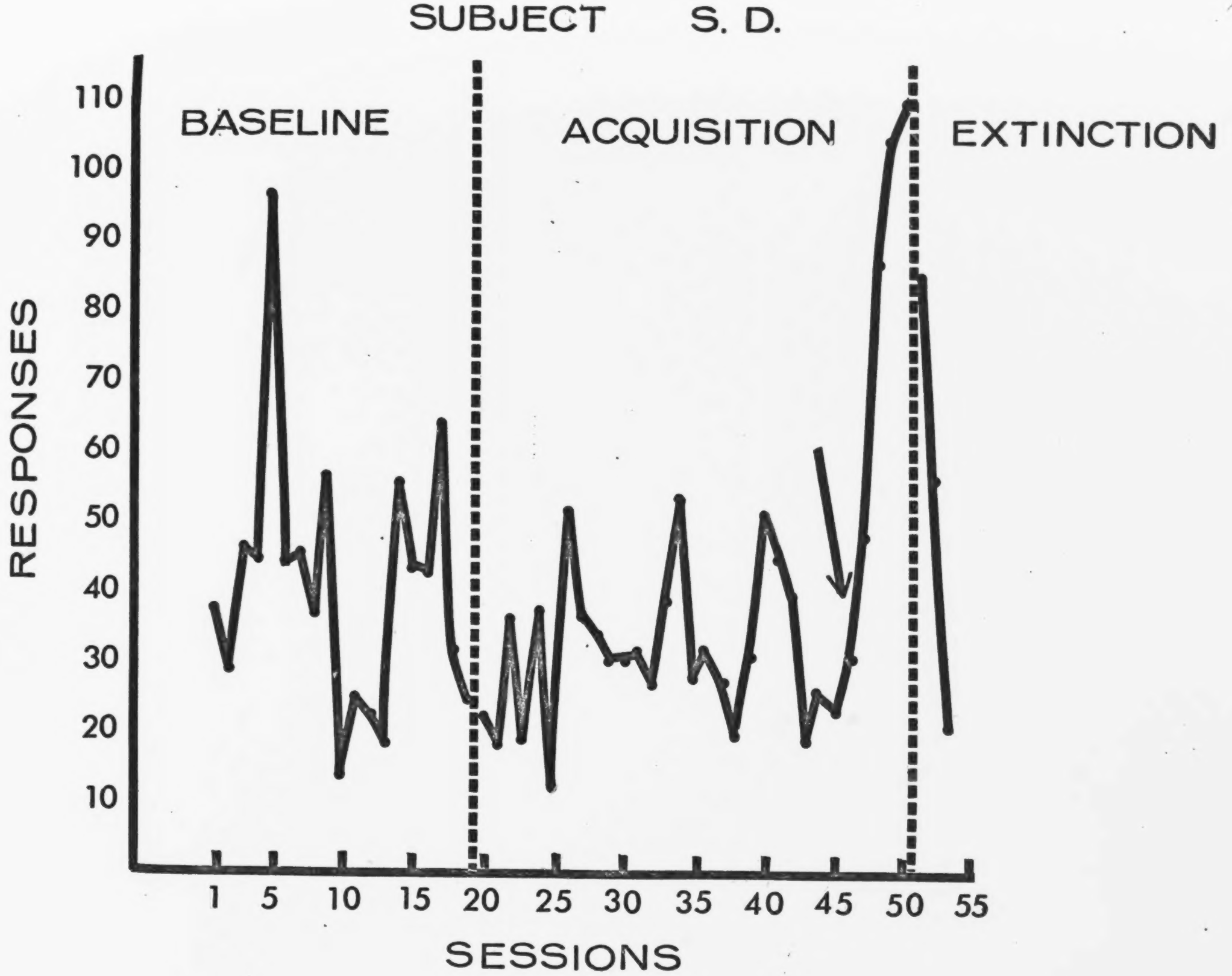

BASELINE
ACQUISITION
EXTINCTION
REACQUISITION
EXTINCTION
RESPONSES
160
140
120
100
80
60
40
20
1
5
10
15
20
25
SESSIONS

Fig. 16. Baseline, acquisition and extinction data for S.D.


SUBJECT S. D.
BASELINE
ACQUISITION
EXTINCTION
RESPONSES
110
100
90
80
70
60
50
40
30
20
10
1 5 10 15 20 25 30 35 40 45 50 55
SESSIONS

photic stimulation contingent on the utterance of a Human Response resulted in an increase in the frequency of the response. The remaining subjects failed to show an increase in response rate or exhibited a reduction in response rate when the contingency was introduced. These apparently diverse results across subjects warrant discussion and, if possible, a rationale suggested to account for the observations.

Noxiousness of Light Intensity

Among the earlier formulations regarding the effects of intense stimulation on the behavior of organisms was that of Thorndike (1911). He suggested that the administration of intense stimulation to an organism which resulted in a subjective state experienced as an "annoying after effect" was punishing to the organism. Thorndike's formulation quickly proved inadequate since it relied on the necessity of assessing a subjective state. Related efforts have stressed operational definitions and have in the main restricted themselves to the operations which were performed and the results ensuing therefrom. Thus, Dinsmoor (1954) defines punishment in procedural terms as the delivery of an aversive stimulus following a response. Pertinent to our problem here, Dinsmoor defined an aversive stimulus as one that increases the probability of the responses which terminate the stimulus. It is apparent that both Dinsmoor's and Thorndike's definitions are ultimately empirical, inasmuch as prior to the introduction of the contingency, no predictions can be made concerning the expected outcome. Further, these formulations are circular since a particular stimulus can only be defined as being aversive after it results in response changes.

Thus the scientific utility of conditioning procedures could be greatly enhanced if an independent means of estimating the aversiveness of a particular stimulus prior to conditioning procedures was available. If this were obtained, the possibility of failure to achieve conditioning could be linked directly to parametric considerations, and a method or technique which has considerable value would not likely be cast out. Premack (1959) has suggested a similar point of view and advocates rigid analysis of the operant occurrences of reinforcing and punishing stimuli prior to experimental manipulation.

While the feasibility of this procedure as a precursor to conditioning procedure is apparent, it has in fact been seldom used in verbal conditioning or in conditioning of more common motor responses. Failure to employ this method or a similar one casts doubt on many verbal conditioning experiments reported in the literature and greatly restricts and often precludes generalization of the ensuing data.

In the study reported in this manuscript, independent estimations of the aversiveness of the stimulus lights were made for each subject. In order to explain the behavior of the subjects during acquisition procedures, reference must now be made to their performance in the preconditioning procedure in which a button-push resulted in cessation of the lights.

It will be remembered that for sake of discussion button-pushing behavior for the subjects was presented in three groups. In Group I, regardless of intensity of the lights, none of three subjects reached a level above 30% of the theoretical maximum (Figure 2). Conditioning data for these three subjects, D.M., D.D., and S.L., are presented in Figures 5, 6, and 7 respectively. Inspection of Figure 5 reveals that although the maximum intensity was employed, subject D.M. showed no increases in response

rate, and no conditioning effects were apparent. Subject C.C. (Figure 6) also behaved in a manner which did not give rise to discernable conditioning effects. The final subject in Group I, Subject S.L., similarly showed no indication of conditioning, and in fact, response rates were actually lower during contingent sessions than that observed during the baseline period.

Thus, for the three subjects in Group I, all of whom responded at a magnitude less than 30% of maximum during button pushing session, no conditioning took place.

Button-pushing data for Group II are presented in Figure 3. This group, which is comprised of six subjects performed at a level below 60% of the theoretical maximum but above 30%. Of these six subjects, four conditioned (L.D., D.F., J.C., D.E.) and two failed to condition (J.L. and S.H.).

The last group, Group III was comprised of three subjects, E.S., J.R., and S.D. These subjects performed on the button-pushing segment of the experiment by achieving a level above 60% of the theoretical maximum (Figure 4). Consultation of corresponding conditioning data for these subjects (Figures 14, 15, and 16) reveals that all three showed substantial and reliable conditioning effects.

The summary of comparisons of button-pushing and conditioning data reveal that all subjects who in pre-conditioning aversive evaluation responded below 30% failed to condition. Those who responddd above 60% conditioned in all instances. Of those who fell in the middle group, thus responding at a level below 60% but above 30%, four conditionéd and two showed no effects of the contingency.

Conclusions drawn from the above discussion are the following:

1. The subjective aversiveness of the reinforcing stimuli is highly ideosyncratic and subject specific.

2. This ideosyncratic estimation of aversiveness is highly critical, and the stimulus must reach a minimal level of aversiveness as a necessary pre-requisite for conditioning.

3. If the data gleaned from the present can serve as a reference, aversiveness must reach a level of approximately 50% or higher before conditioning can be expected to take place.

Number 3 above must be restricted to the particular experimental paradigm which was employed in this research project. It is not expected that this critical percentage would hold for other forms of aversive conditioning procedures such as signal avoidance or escape conditioning without an avoidance option.

Awareness and Conditioning

The issue of awareness in regards to verbal conditioning is one that has received considerable attention in the last few years. The controversy revolves around the original statement by Skinner (1953) that reinforcement is immediate and automatic. Implicit in Skinner's statement is the idea that reinforcement has its effect regardless of individual expectancies or other perceptual or conceptual intervening processes. In the area of verbal conditioning, Greenspoon (1954) adopted a position similar to Skinner's formulations and dealt with reinforcement as the primary independent variable and thus disregarded all intervening states or conditions. Speilberger and DeNike (1962) did a series of studies which supported the notion that conditioning occurred only when the individual was "aware" of the contingency. Awareness was assessed by post-experiment questionnaires which purported to estimate the degree to which the subject understood what the reinforcing event was, and what he had to do to receive it. Speilberger and DeNike concluded that awareness of the contingency was critical, and that if the subject was not aware, conditioning would not occur. In a rebuttal, Greenspoon (1963) disagreed with the suggestions of Speilberger and DeNike and reinterated his position that awareness was a separate question and was not of concern in verbal conditioning studies of the type which he had performed.

While it was not the intent or purpose of the current experiment to deal with the awareness issue, in some instances interpretation of the data can be facilitated if a few salient points are made. It will not be argued as to whether awareness is or is not a requisite for verbal conditioning. It will be pointed out, however, that when and for whatever reason the subject does become aware of the contingency, the fact that the subject is aware may drastically affect the outcome of the experiment and interpretation of the data.

In an earlier study, Whaley and Dela Vergne (1964) found that awareness played an important part in understanding some of the data. Similar to the present experiment, intense illumination was terminated for a brief period of time when the subject uttered a predetermined class of verbal responses. For one subject, the correct response was a first person pronoun, either I or WE. After securing an adequate baseline the contingency was introduced and the subject responded by increasing the frequency of the contingent response. This increase was initially substantial and it appeared that conditioning was taking place. On the following session, however, response frequency dropped to a level drastically below baseline and remained there throughout the experiment. Although intensity was increased to the maximum, response rate remained significantly below baseline. Also noted was that the variability which was noted during baseline and in the inttial conditioning sessions dropped out and performance remained at a high level of stability with little or no variation from session to session. After termination of the experiment, the subject was questioned as to whether she was aware of the contingency. She was able to specify the contingency exactly and further remarked that she had purposely refrained from uttering the correct response because she resented the feeling that she was being controlled by the experimenter.

In the present study, similar trends in the responding of individual subjects were discernable. Subject D.M. (Figure 5) responded during the baseline session with a degree of variability which was considerable. After the contingency was introduced on session 14 response frequency became greatly reduced and responses became more stable across sessions. Intensity was increased over three jumps to the maximum of 140 volts without resulting in any deviation in this form of responding. It will be noted that pre-conditioning determinations on the aversiveness of the lights was low for this subject, and fell in the Group I classification (Figure 2). Similar modes of responding were observed for subject C.C. (Figure 6) and subject S.H. (Figure 9). Subject C.C. responded in aversiveness determinations in Group I and subject S.H. in Group II. Several features were obvious with these subjects and was similar to that observed by Whaley & Dela Vergne (1964): (1) When the contingency was introduced, responding dropped to a level below that observed in the baseline period and remained there throughout the remainder of the experiment, (2) Variability decreased with the introduction of the contingency, (3) Subjects verbalized an awareness of the contingency at one point or another during the experiment, and (4) These subjects responded during preconditioning sessions in a manner which indicated that the stimulus lights were minimally aversive.

These events give rise to a hypothetical set of circumstances which may prove to be critically important to further verbal conditioning studies. It is suggested that the most important factor which awareness of the contingency contributes is that fact that it seems to result in reduced variability. This may perhaps be explained by the possibility that the subject, once being aware of the contingency, consciously adjusts his behavior to the situation. Responding, thus being under the conscious control of the subject, is less sensitive to comparatively gross changes in the stimulus complex. The increases in intensity were not reflected in response frequency. Once the contingency is learned by the subject, and she is aware of the conditions under which reinforcement will be enacted, the decision as to whether she will cooperate with the schedule or oppose it, is within most ranges of intensity not under complete control of the independent variable. The same would be true for extinction and reacquisition phases. Many other variables largely comprised of prior learning, attitudes, and history, determine the direction and mode of the subject's performance. If, however, intensity is increased to a level which is truly unbearable for the subject, it would be expected that she would perform in a manner which minimizes light-on duration and frequency. From this rationale, it is interesting to note that the three subjects who displayed the reversal in the predicted direction of conditioning were among those for whom the lights were least aversive. If a greater range of intensity had been available, it is possible that this reversal could have been obviated and behavior observed in the predicted direction.

Summary and Conclusions

The educational process consists most conspicuously in modification of the verbal behavior of the individual student. In general the methods which have been used in the past have been only partially effective and have differed greatly from student to student and with different instructors for the same student.

The advantage of the verbal conditioning approach is that it proposes to examine under a scientific rubric a process which has previously been observed in a more or less haphazard manner. It is hoped that techniques will evolve from this experimentation which will help to take some of the variability from the educational process in general, and will allow for precise and specific manipulation of verbalization.

The research presented in this manuscript illustrates an example in which verbal content was experimentally manipulated in a situation which could only broadly be considered interpersonal. In fact, the experimenter did not interact with the subject during a session, and from the subject's point of view the control exerted on her was essentially impersonal.

The results of this experiment indicated that under these conditions verbal content could be manipulated. Further, the efficacy of this procedure was definitely linked to the motivational properties the aversive stimulation held for each particular subject.

It is believed that verbal conditioning holds great promise for future educational techniques and that mass training such as an entire class or group by similar means will soon be feasible. It is felt that the present experiment demonstrates this point and that failings of the procedure experienced were more of a technical or parametric nature and only point to the need for further experimentation along these same lines.

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Table 1

Level of Illumination Corresponding to Voltages Used in this Study

Voltage	Illumination in Ft. Candles
50	180.0
65	415.0
80	870.0
95	1217.0
110	1360.0
125	1380.0
140	1420.0

Note.--Light measurements were made with an SEI photometer at approximately 24 inches from light source.

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DATE FILMED 12.15.66